JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1986, 46, 45–49 NUMBER 1 (JULY)

OBSERVATIONAL LEARNING OF TWO VISUAL DISCRIMINATIONS BY PIGEONS: A WITHIN-SUBJECTS DESIGN

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Pigeons' observational learning of successive visual discriminations was studied using within-subject comparisons of data from three experimental conditions. Two pairs of discriminative stimuli were used; each bird was exposed to two of the three experimental conditions, with different pairs of stimuli used in a given bird's two conditions. In one condition, observers were exposed to visual discriminative stimuli only. In a second condition, subjects were exposed to a randomly alternating sequence of two stimuli where the one that would subsequently be used as S+ was paired with the operation of the grain magazine. In a third experimental condition, subjects were exposed to the performance of a conspecific in the operant discrimination procedure. After exposures to conspecific performances, there was facilitation of discriminative learning, relative to that which followed exposures to stimulus and reinforcement sequences or exposures to stimulus sequences alone. Exposure to stimulus and food-delivery sequences enhanced performance relative to exposure to stimulus sequences alone. The differential effects of these three types of exposure were not attributable to order effects or to task difficulty; rather, they clearly were due to the type of exposure.

Key words: observing, stimulus preexposure, within-subject control, key peck, pigeons

Investigations of observational learning have for the most part used between-subject designs. Such studies have entailed four sets of observational arrangements: (1) exposure to visual discriminative stimuli only (reviewed by Hall, 1980), (2) exposure to stimulus-reinforcer sequences in the absence of a model (Brown & Jenkins, 1968; Zentall & Hogan, 1975, 1976), (3) exposure to proficient discriminative performance by conspecifics (Groesbeck & Duerfeldt, 1971; Huang, Koski, & DeQuardo, 1983; Kohn & Dennis, 1972; Palameta & Lefebvre, 1985), and (4) exposure to nonproficient conspecifics (Darby & Riopelle, 1959; Herbert & Harsh, 1944; Myers, 1970; Presley & Riopelle, 1959). Vanayan, Robertson, and Biederman (1985), Del Russo (1975), and John, Chesler, Bartlett, and Victor (1968) have studied the effects of observing both proficient and nonproficient conspecifics. In addition to the dependence on between-subject comparisons, these experiments have not made systematic comparisons of all four of the arrangements mentioned, in any single study. Comparisons that have been made have shown that exposure to a conspecific performing the to-be-learned discrimination facilitates subsequent learning relative to that of a control group; exposure to the stimulus-reinforcer contingency has also been found to enhance subsequent acquisition in comparison to the learning of a control group, and exposure to the discriminative stimuli facilitated performance, again, in contrast to the performance of a control group. In other between-subject studies, Del Russo, John et al., and Vanayan et al. have studied the effects of exposure to both proficient and nonproficient models and have reported contradictory results.

The present research was designed to examine a new procedure for studying observational learning; a within-subjects design was used to evaluate the relative effects of prior exposure to different experimental conditions. Three sets of comparisons were used, which permitted investigation of the relative importance of each type of exposure. The first comparison examined acquisition of discriminative performance when there had been exposure to the two discriminative stimuli and the S+ had been paired with inaccessible grain; this was compared to the same birds' acquisition of discriminative performance with

This research was supported by grants from the Natural Sciences and Engineering Research Council of Canada to G. B. Biederman. We thank G. A. Heighington for expert technical assistance. Reprint requests may be sent to G. B. Biederman, Division of Life Sciences, Scarborough Campus, University of Toronto, Toronto, Ontario, Canada M1C 1A4.

respect to a second pair of stimuli whose prior exposure had not included food deliveries. A second comparison was between acquisition of discriminative performance on a procedure for which performance had been modeled by a conspecific during prior exposure, and acquisition of performance in a similar discriminative procedure in which, during prior exposure, the current S+ had been paired with inaccessible grain. Third, acquisition of discriminative performance on a procedure for which performance had been modeled by a conspecific during prior exposure was compared with the performance of the same birds in a second discriminative procedure where visual stimuli had been presented without food deliveries during the prior exposure.

A common-sense analysis of the relative information present in each of the three exposure conditions might predict that exposure to a performing conspecific would be more facilitatory in comparison to any other exposure condition, and that prior exposure to the stimulus-reinforcer sequence in the absence of a conspecific would be relatively more effective than exposure to the stimuli alone. However, with the possible exception of the report of Groesbeck and Duerfeldt (1971) indicating the relative importance of exposure to models in contrast to other types of prior exposure, there is no direct evidence in the between-subject literature to enable a prediction to be made concerning the relative efficacy of the three exposure conditions.

METHOD

Subjects

Six experimentally naive male White King pigeons, about 6 years old, served as subjects. The animals were purchased from the Palmetto Pigeon Plant and were maintained at approximately 80% of their free-feeding weights. Four additional adult males from the same source served as models.

Apparatus

Three experimental stations with associated automation were used (see Vanayan et al., 1985). Each compartment was provided with 80-dB masking noise and with independent ventilation. These stations (constructed of 2-cm plywood and measuring 85 cm wide by 42 cm deep by 39 cm high) were subdivided into observation and testing compartments. A one-key response panel was located on the front wall of the testing compartment. The rear wall of this compartment was a 0.5-cm thick sheet of Plexiglas. The front wall of the observation compartment was a 0.5-cm thick one-way mirror with the reflective surface facing the testing compartment. Thus, when a model was placed in the testing compartment, the observer could view the model without the model detecting the presence of the observer, as confirmed in pilot experiments. In those pilot studies, pigeons were placed in the observation compartment while other pigeons in the model's compartment were responding at asymptote under various schedules of food reinforcement (i.e., fixed interval, variable interval, fixed ratio, variable ratio). No disturbance was evident to the experimenters viewing these animals through lenses nor in the cumulative records of the model's performance at the point of the introduction of the observer and subsequently over two 8-hr sessions during which the observer had been continuously present. Following these sessions, the observer was removed and the model's performance remained stable over an additional 8-hr session of food-reinforced responding.

Procedure

Each session consisted of 120 trials of exposure followed by 120 trials of training. There were three sessions for each bird, with 48 hr between the onsets of exposure periods. Two pairs of visual stimuli were used, one involving triangles and the other involving dots. In the former, an inverted solid triangle was positively correlated with food (S+), and an erect triangle was negatively correlated with food (S−). In the other pair of stimuli, three horizontal dots were positively correlated with food delivery and three vertical dots were negatively correlated (cf. Biederman, 1968). Prior to the experiment, 2 pigeons that were to serve as models were trained in each of the discrimination procedures until they reached proficient levels of performance (see Vanayan et al., 1985). Each training session for these models consisted of a random sequence of 60 S+ and 60 S− trials; sessions were held on alternate days. A given model performed only one of the two discrimination tasks and was trained until a session in which a learning index (L) of at least 0.7 was attained. L was defined as the difference between the proportion of S+ trials in which a response occurred and the proportion of S− trials in which at least one response occurred (i.e., L = [number of S+ responses/30] − [number of S− responses/30]). Three experimental conditions were used: exposure to the discriminative stimuli only (S), exposure to the discriminative stimuli where the stimulus to be used as S+ was paired with inaccessible food reinforcement (SR), and exposure to a conspecific's task performance—that is, exposure to stimuli, models' responses, and response-contingent food delivery (SMR). In Condition S, subjects were exposed to a random sequence of the stimuli from one pair. The duration of each stimulus presentation was 20 s and the intertrial interval (ITI) during which the key was darkened and deactivated was 40 s. In Condition SR, subjects were exposed to a sequence of stimuli from one pair, where the stimulus to be used as S+ was presented for 20-s periods, followed by the automatic elevation of the grain-filled magazine for 2 s, followed by a 40-s ITI. The stimulus to be used as S− also appeared for 20-s periods and was followed by a 40-s ITI. In Condition SMR, subjects were exposed to a model responding in the presence of stimuli from one of the two pairs. The model's responses at S+ produced 2-s access to grain followed by a 40-s ITI; a model's peck at S− resulted in a 20-s delay before the start of the ITI; thus, responding on S− prolonged its exposure.

The key-peck response of the pigeons was autoshaped (Brown & Jenkins, 1968) using illumination of the response key with uniform white light and 2-s presentations of food. The experiment began 1 week later, when 2 pigeons were randomly placed in each of three groups, S:SR, SR:SMR, and S:SMR. During exposure, subjects were given 60 trials with one pair of stimuli in one exposure condition, followed by 60 trials with the other pair of stimuli in the second exposure condition. There were 30 S+ trials and 30 S− trials intermixed in each set of 60. The stimulus that appeared on the key was randomly selected from the pair, with the restriction that no more than three of the same stimuli appear successively.

Following exposure, subjects were placed in the testing compartment; each subject was

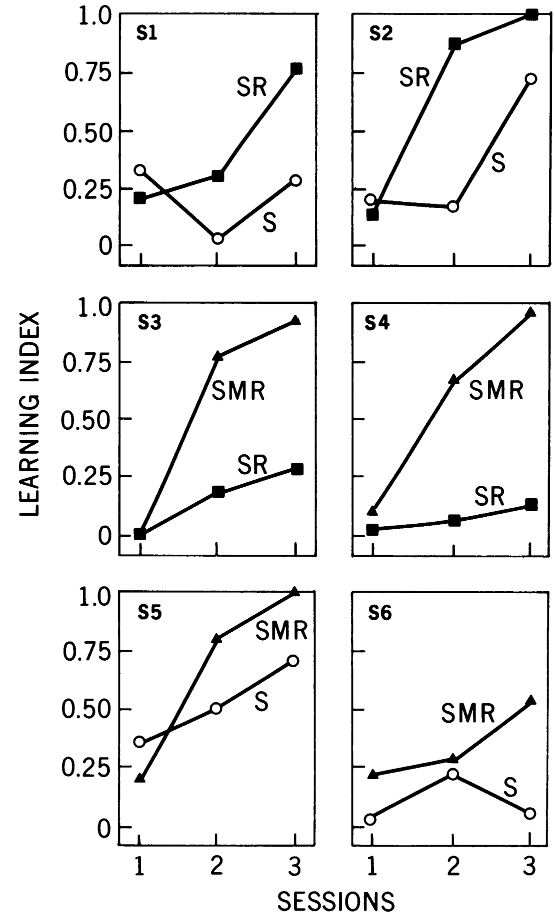

Fig. 1. Learning index per session for each subject, for two pairs of discriminative stimuli. Each pair of stimuli was presented in one of the three experimental conditions (S, SR, and SRM) immediately prior to each of three sessions of training. See text for explanation of conditions.

given discrimination training with both pairs of discriminative stimuli. The training sessions consisted of six blocks, each of which included 10 presentations of each pair of stimuli. The blocks alternated between the two discriminations, and within each block the sequence of S+ and S− was randomly predetermined with the restriction that no more than three of the same stimuli appear successively. Within each block there were five S+ and five S− trials for both pairs of stimuli (a total of 20 trials per block). Thus, a test session included 30 S+ and 30 S− trials for each pair, over six blocks. For each subject, the block of trials presented first alternated between the

Table 1

Individual subject responses in S+ and S− by condition.

Subject	Condition			
Subject 1	SR		S	
	S+	S−	S+	S−
Session 1	19	12	21	11
Session 2	30	21	25	26
Session 3	30	7	30	22
Subject 2	SR		S	
	S+	S−	S+	S−
Session 1	27	23	27	21
Session 2	30	6	28	23
Session 3	30	0	30	8
Subject 3	SR		SMR	
	S+	S−	S+	S−
Session 1	23	23	25	25
Session 2	26	20	30	7
Session 3	30	21	30	2
Subject 4	SR		SMR	
	S+	S−	S+	S−
Session 1	12	11	6	3
Session 2	28	26	30	10
Session 3	26	22	30	1
Subject 5	SMR		S	
	S+	S−	S+	S−
Session 1	27	21	26	15
Session 2	30	5	29	14
Session 3	30	0	27	6
Subject 6	SMR		S	
	S+	S−	S+	S−
Session 1	30	21	30	29
Session 2	30	22	29	23
Session 3	29	12	30	28

two discriminations on successive training sessions. During training, the duration of S+ and S− was 20 s unless a response occurred. The first response at S+ produced 2-s access to grain and was followed by a 40-s ITI with the key darkened and deactivated. Each peck at the key during S− resulted in a 20-s delay before the start of the ITI (on each trial the possible number of responses on S− was unlimited). The delays were not cumulative but restarted with each S− response; during each delay S− was not removed, but for scoring purposes only the first S− response of a given trial was counted as an incorrect response.

RESULTS AND DISCUSSION

Each subject's acquisition of discriminative performance is portrayed in Figure 1. The results for the three groups show that subjects performed better in the discrimination training procedure when S+ was paired with inaccessible food reinforcement during exposure than they did in the training procedure with stimuli that had been exposed without correlated food deliveries (SR > S). In addition, subjects performed better in training on the discrimination procedure for which effective performance had been modeled by a conspecific than they did in training on the discrimination procedure using an S+ that had been paired with inaccessible grain (SMR > SR). Finally, the acquisition of performance after exposure to the modeled discriminative performance was better than the same subjects' acquisition of discriminative performance in the procedure whose stimuli had been presented alone during exposure (SMR > S). These findings confirm prior evidence from between-subject experiments contrasting experimental and control groups; here, however, the results are shown for individual subjects serving under two of three experimental conditions.

Table 1 gives individual subject performances under S+ and S− for each experimental condition. As shown in the table, two scores were recorded for each stimulus pair during a given test session: number of S+ trials in which a response occurred, and number of S− trials in which at least one response occurred. Both subjects in Condition SR:S performed better on the discrimination with stimuli presented in Condition SR, during the second and third sessions of testing. Subjects in Condition SMR:SR performed better in the discrimination with stimuli presented in Condition SMR than they did in the discrimination with stimuli presented in Condition SR, during every session of testing. By the second and third sessions of testing, both subjects in Condition S:SMR performed better in the discrimination with stimuli exposed in the SMR condition than in the discrimination with stimuli exposed in the S condition. These results suggest that the differential learning scores were obtained as a function of experimental condition and not as a function of level of difficulty or of order of presentation of the two problems.

Exposure to a model's performance was found to facilitate subsequent acquisition of discriminative performance, as has also been reported in the between-subject literature noted in the introduction. Furthermore, exposure to the stimuli where S+ was paired with inaccessible food delivery proved to be more beneficial than exposure to the stimuli alone. This supports Zentall and Hogan's (1975) finding that inaccessible grain may serve as a conditioned reinforcer for pigeons' key pecking. There are interesting differences in the effects of the same exposure condition when contrasted with another exposure condition in the present experiment: Table 1 shows that in Condition SR:S, S− responding sharply declined for the stimulus exposed in the SR condition over the three training sessions for each subject, but in SR:SMR, S− responding during the stimulus exposed in the SR condition shows no such decline and, in fact, increases for Subject 4. These findings suggest that exposure effects may be strongly affected by setting factors and that the role of attention in these types of experimental situation requires additional study.

The experiment reported here is unique in its method; all other experiments in this domain have employed between-subject designs to investigate the role of variables in observational learning. The present procedure reduces error inherent in between-subject designs; the data from this procedure suggest that the within-subjects design may be a useful method for investigating other variables associated with the phenomenon of observational learning and for determining the relative importance of these factors.

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Received June 21, 1985
Final acceptance March 9, 1986